“Servicios ecosistémicos, ecología de las enfermedades y bienestar humano”

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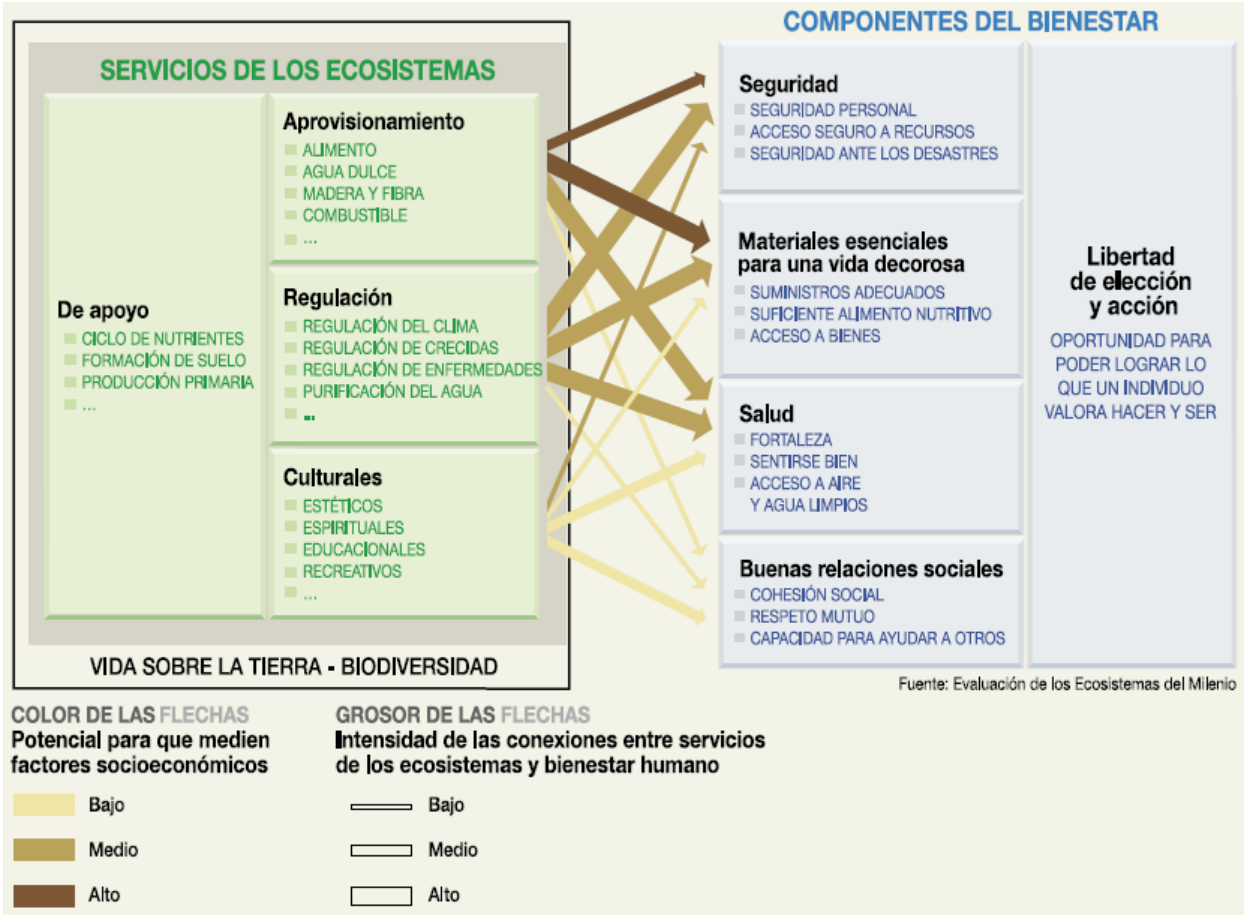
Lanzamiento del Fondo Internacional para Proyectos de Investigación en Ecosistemas (ESPA)

Miraflores, 26 de Enero del 2010

Servicios de los Ecosistemas

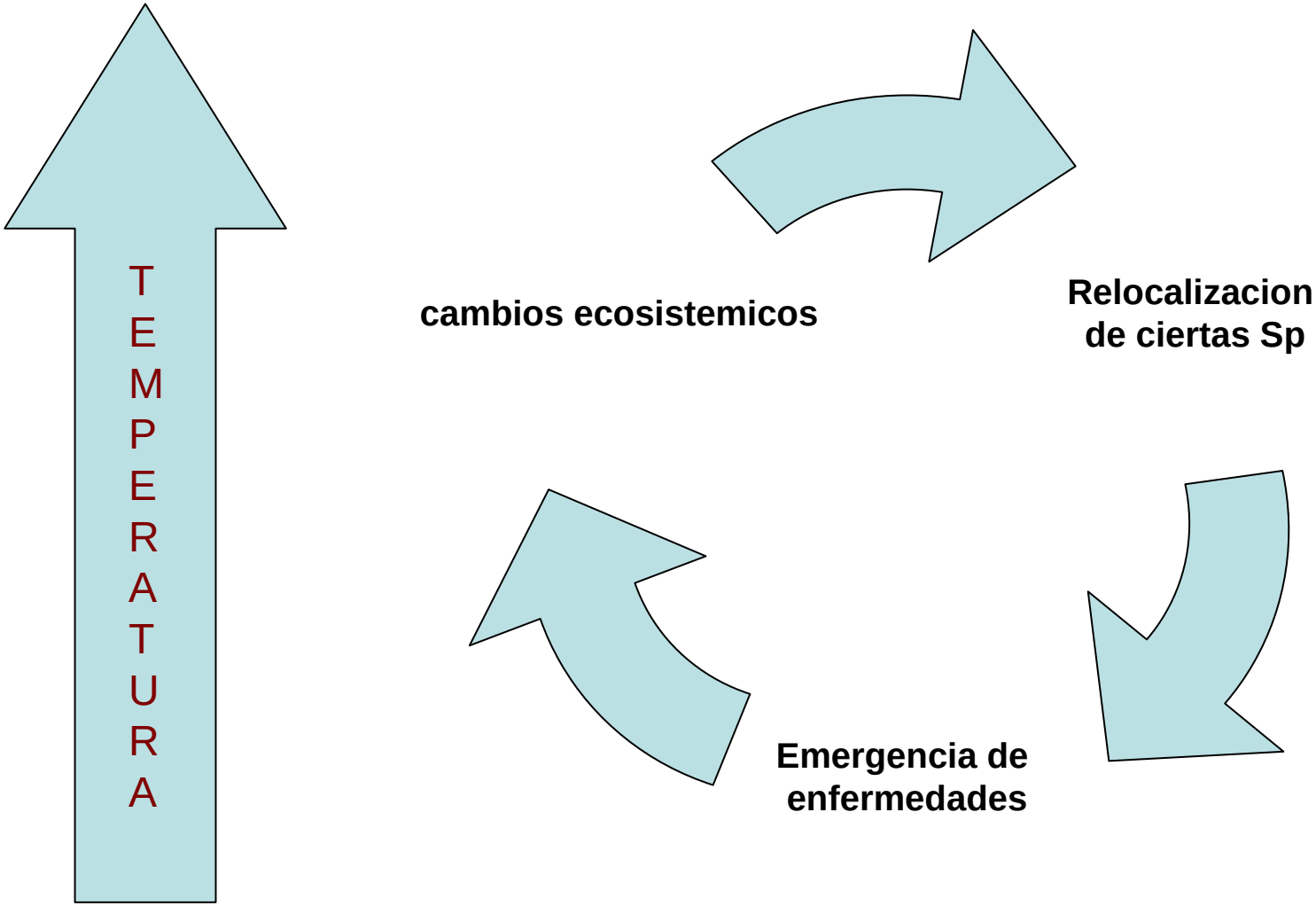
Los beneficios que la gente obtiene de los ecosistemas

Consecuencias de los cambios en los ecosistemas para el bienestar humano

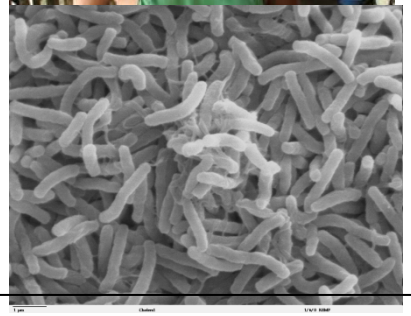


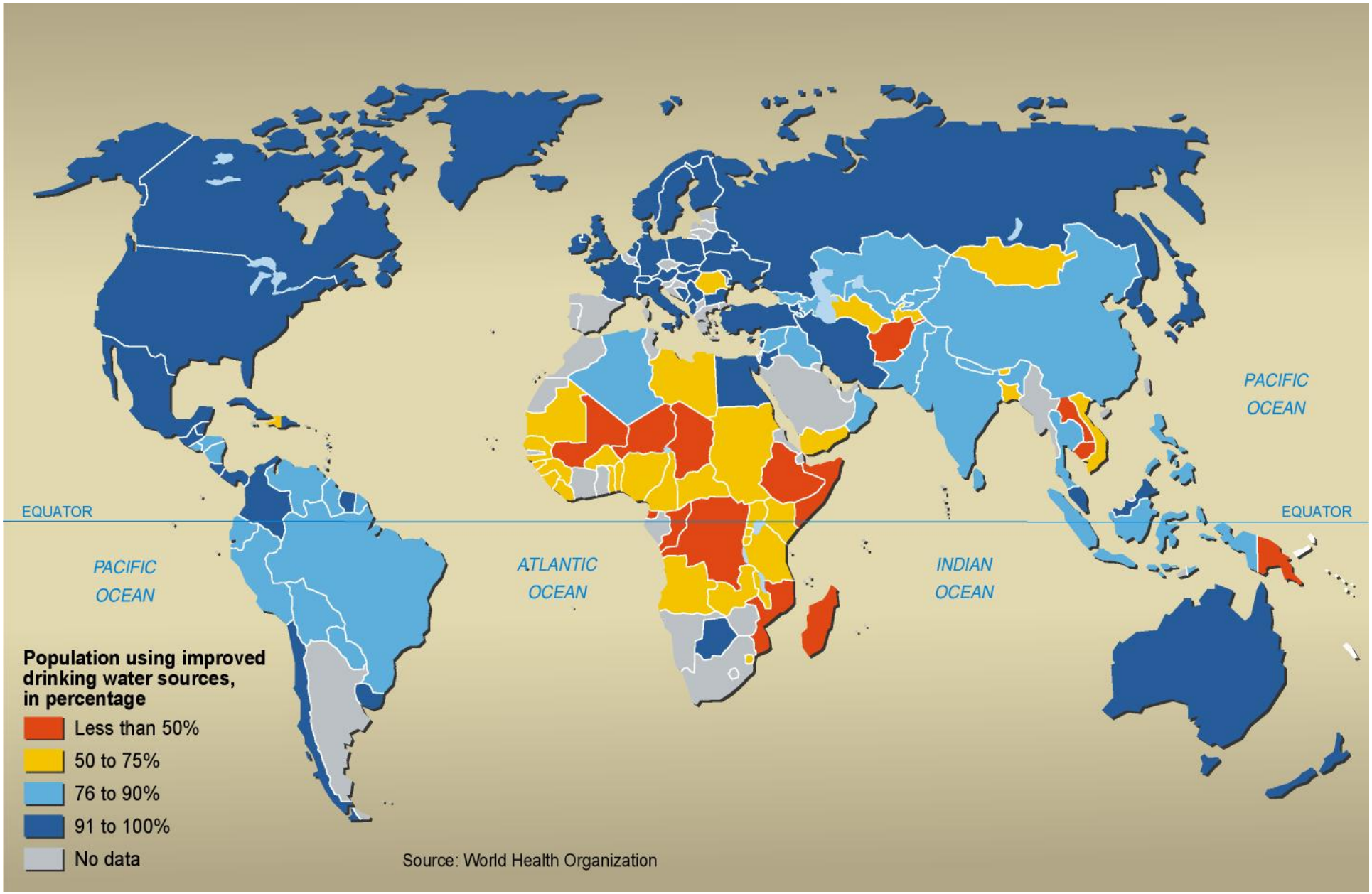
Fuente: Evaluación de los Ecosistemas del Milenio

Regulación del clima

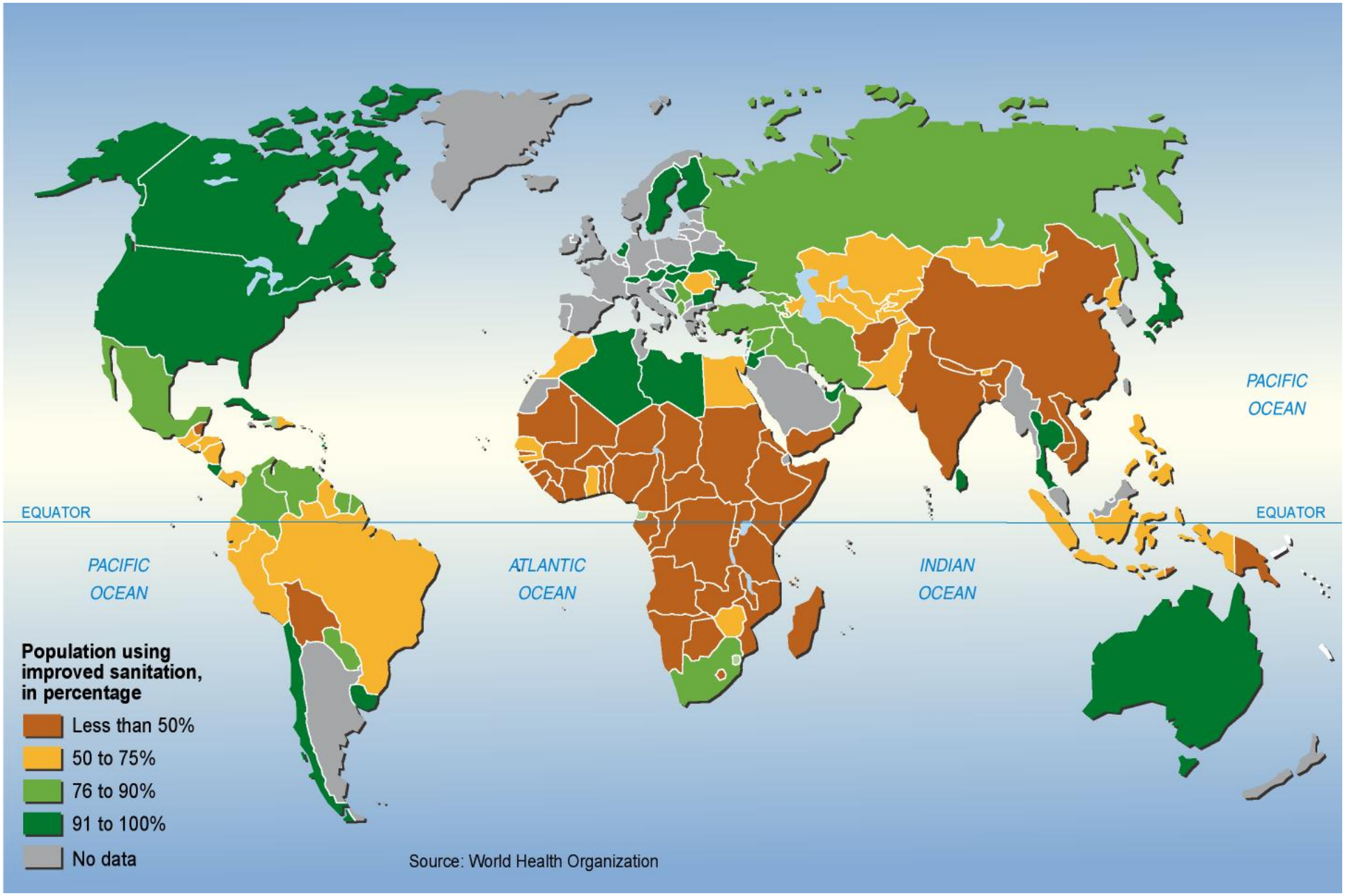


Purificación del agua

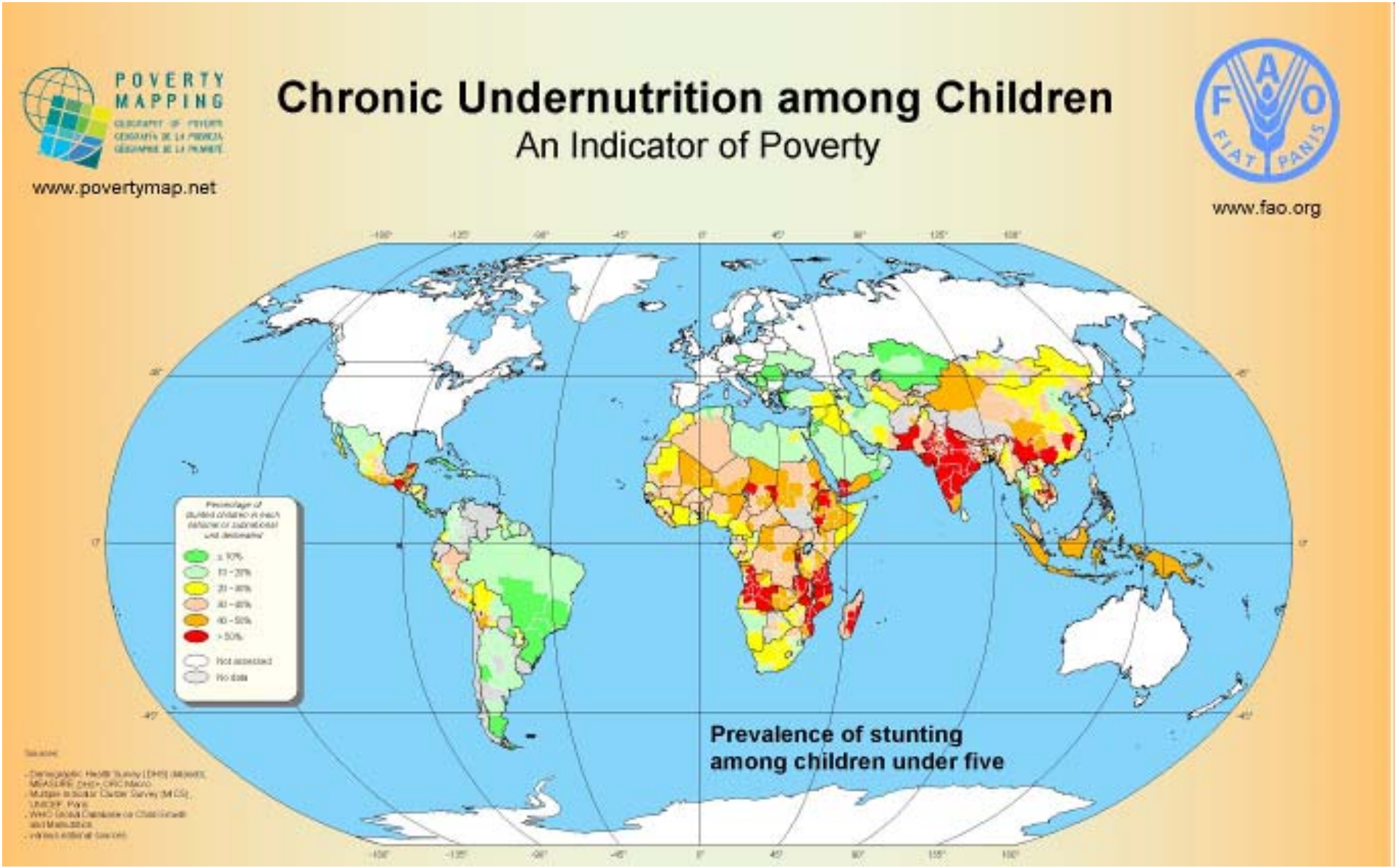




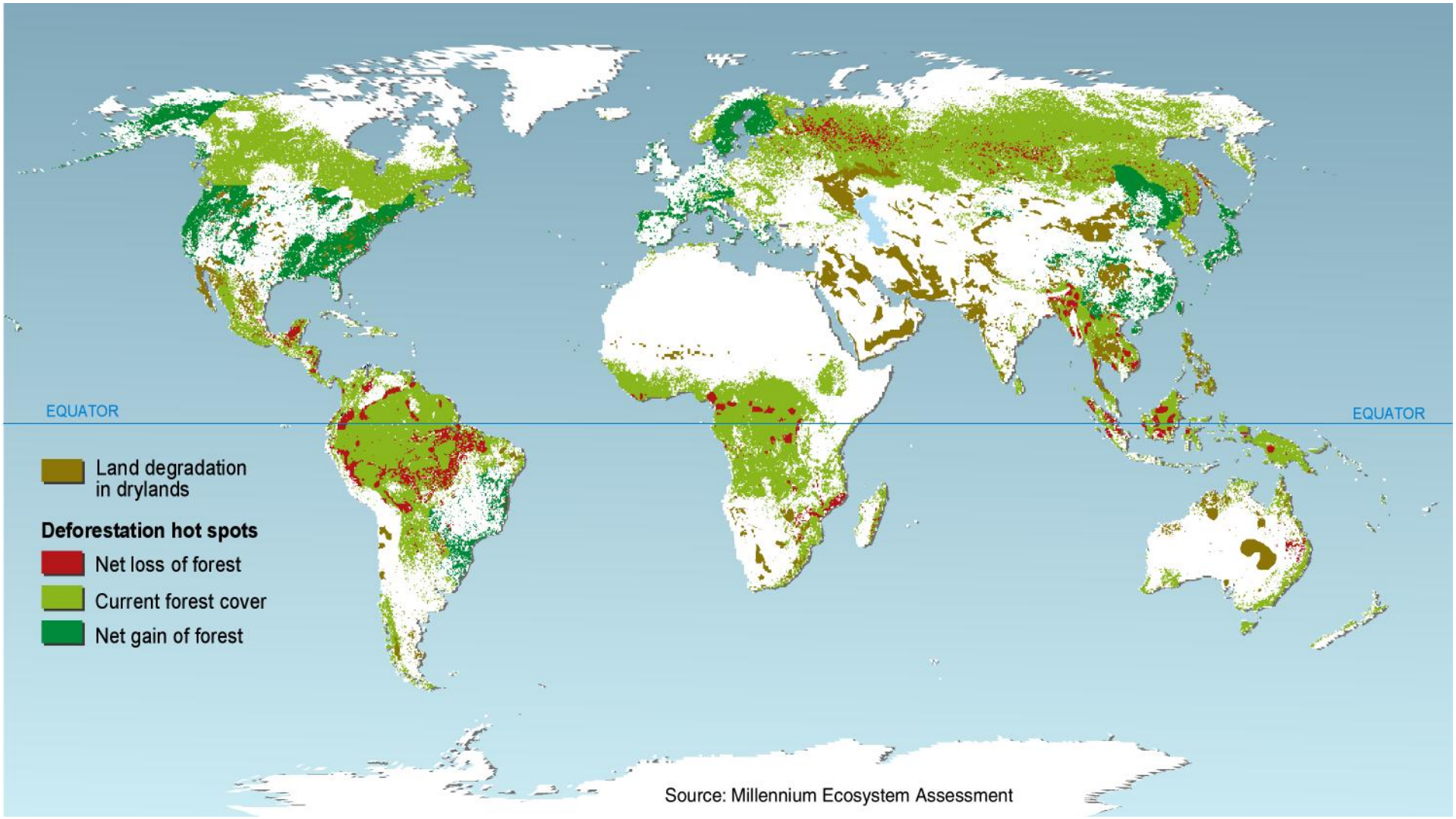
•Unos 1,1oo millones de personas aún carecen de acceso a un suministro adecuado de agua
•La escasez de agua afecta entre 1,000 y 2,000 millones de personas en el mundo



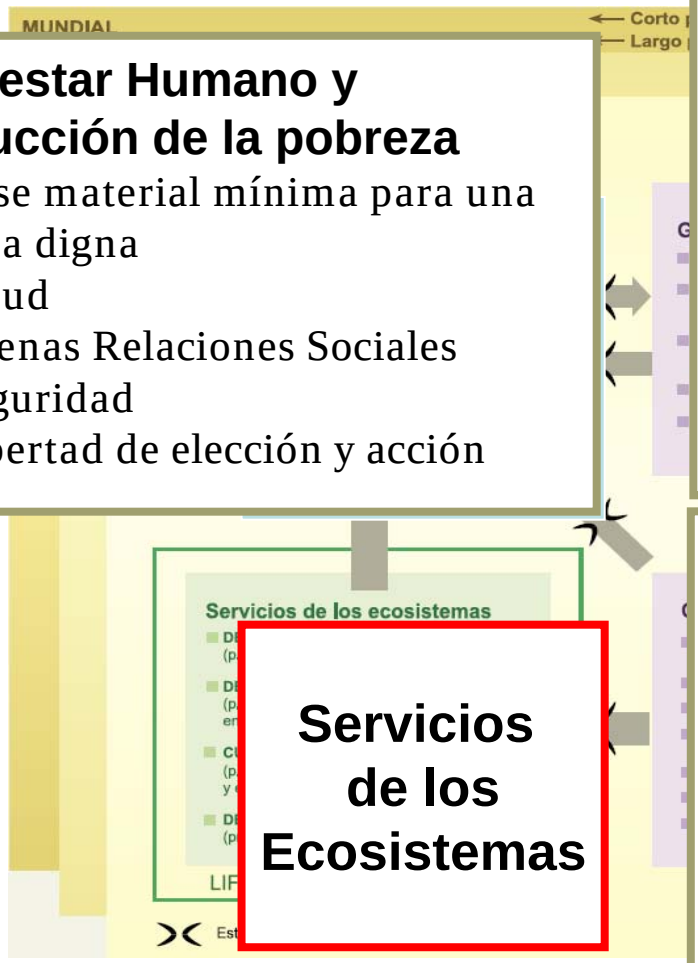
•Más de 2,600 millones no tienen acceso a saneamiento adecuado



•Unas 852 millones de personas estaban desnutridas en el año 2000–02, 37 millones más que en el período 1997–99


EQUATOR
EQUATOR
Land degradation in drylands
Deforestation hot spots
Net loss of forest
Current forest cover
Net gain of forest
Source: Millennium Ecosystem Assessment

Marco conceptual de la EM



Bienestar Humano y Reducción de la pobreza

- Base material mínima para una vida digna
- Salud
- Buenas Relaciones Sociales
- Seguridad
- Libertad de elección y acción

Generadores Indirectos de Cambios

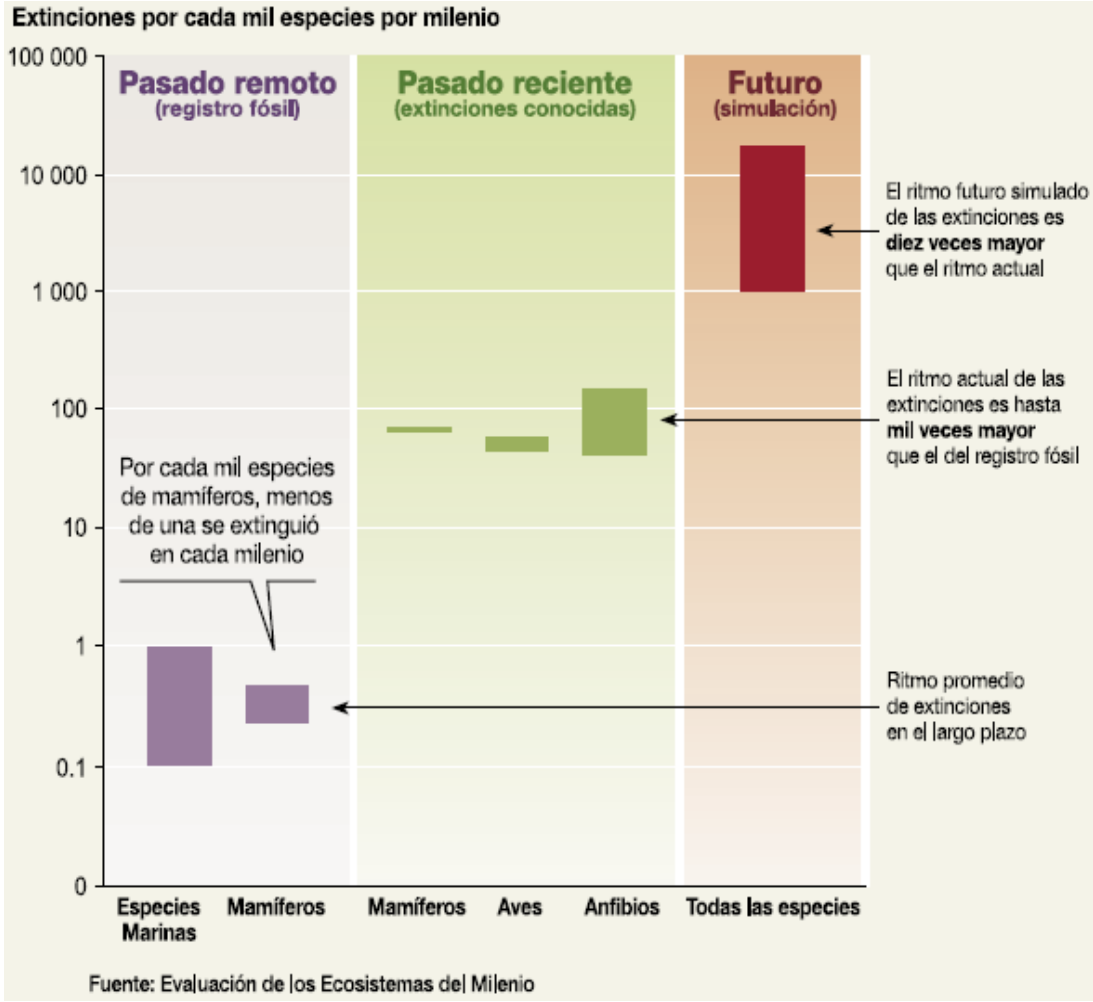
- Demográficos
- Económicos *(globalización, comercio, mercados e instituciones)*
- Sociopolíticos *(gobernanza e instituciones)*
- Ciencia y Tecnología
- Culturales y Religiosos

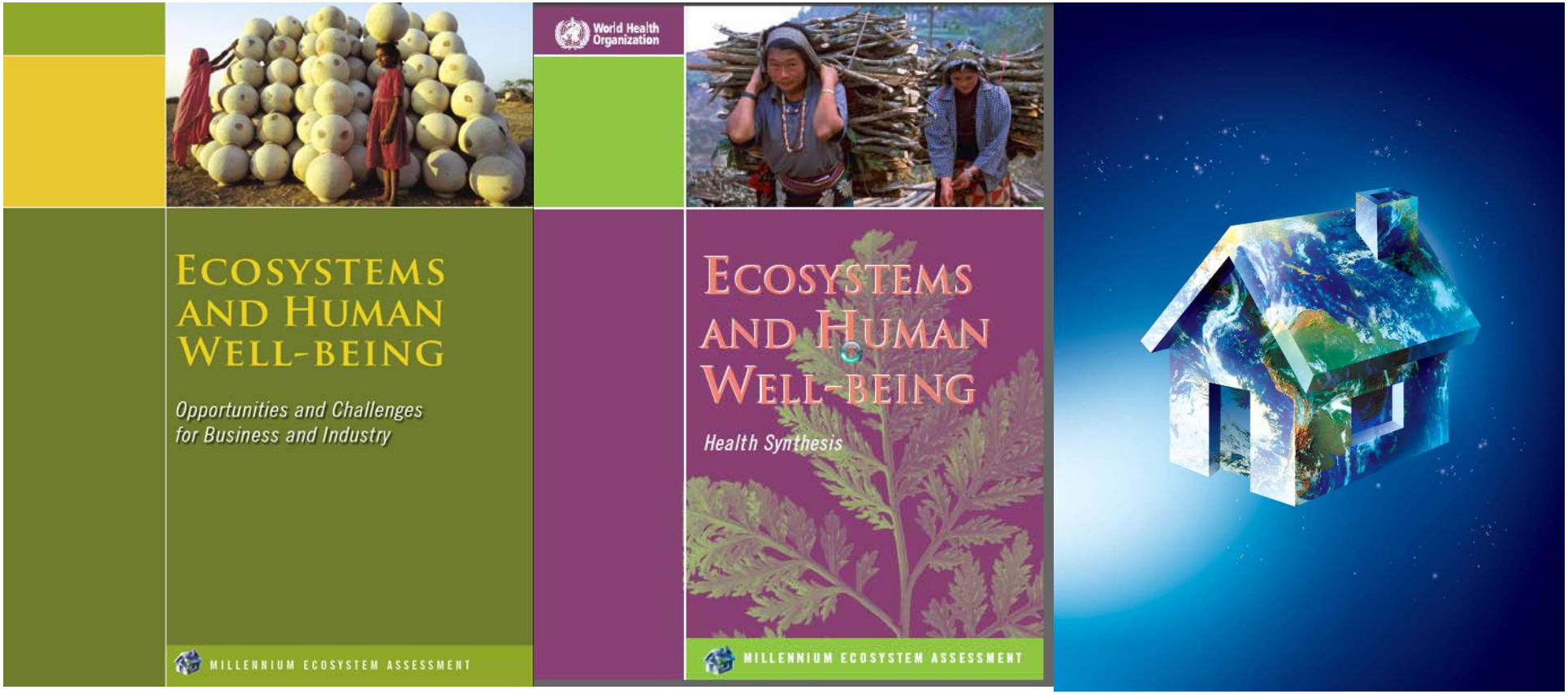
Servicios de los Ecosistemas

Generadores Directos de Cambios

- Cambios en el uso de la tierra
- Introducción o remoción de especies
- Adaptación y uso de tecnologías
- Insumos externos *(p.ej., irrigación)*
- Consumo de recursos
- Cambio climático
- Factores naturales físicos y biológicos *(p.ej., volcanes)*

Cambios significativos y en gran medida irreversibles en la diversidad de las especies

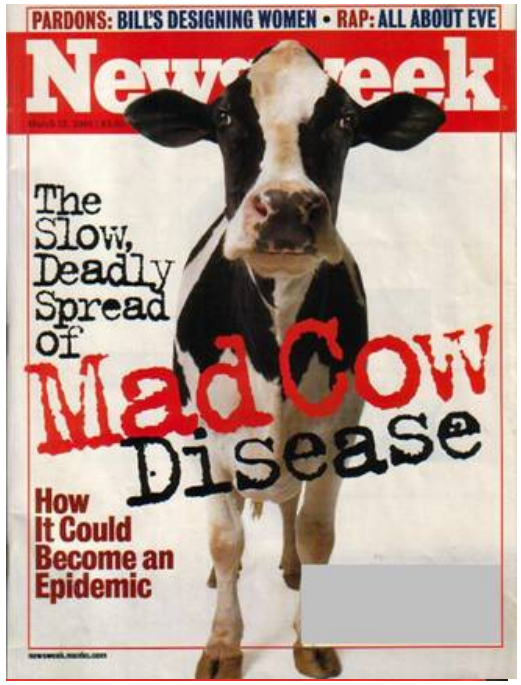



ECOSYSTEMS AND HUMAN WELL-BEING
Opportunities and Challenges for Business and Industry
MILLENNIUM ECOSYSTEM ASSESSMENT
World Health Organization
ECOSYSTEMS AND HUMAN WELL-BEING
Health Synthesis
MILLENNIUM ECOSYSTEM ASSESSMENT

ENFERMEDADES EMERGENTES

Enfermedades que han aumentado su incidencia, han expandido su ámbito geográfico, han sido recientemente reconocidas o que presentan manifestaciones nuevas.

(Daszak et al. 2000a)

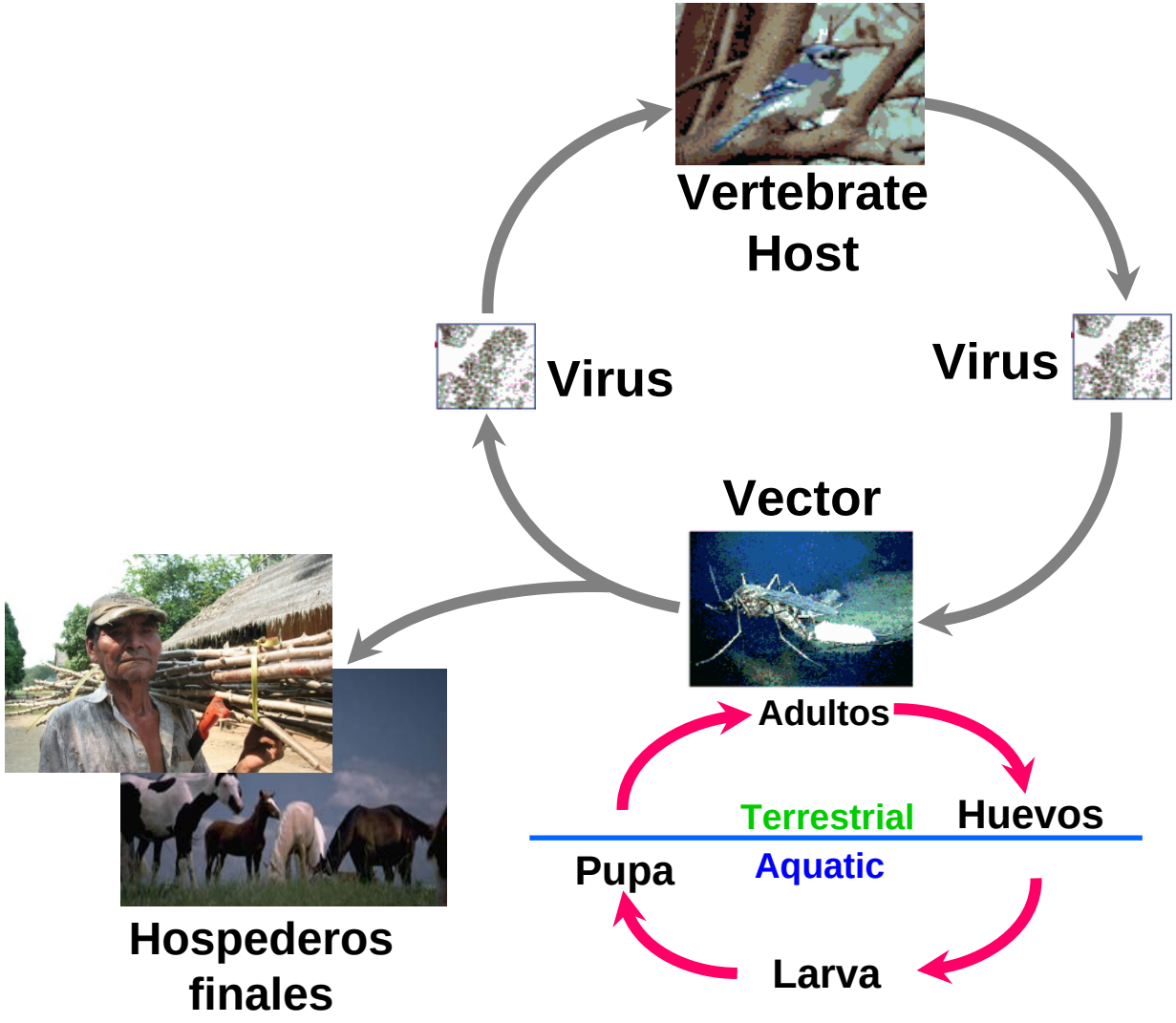


Ecología de enfermedades

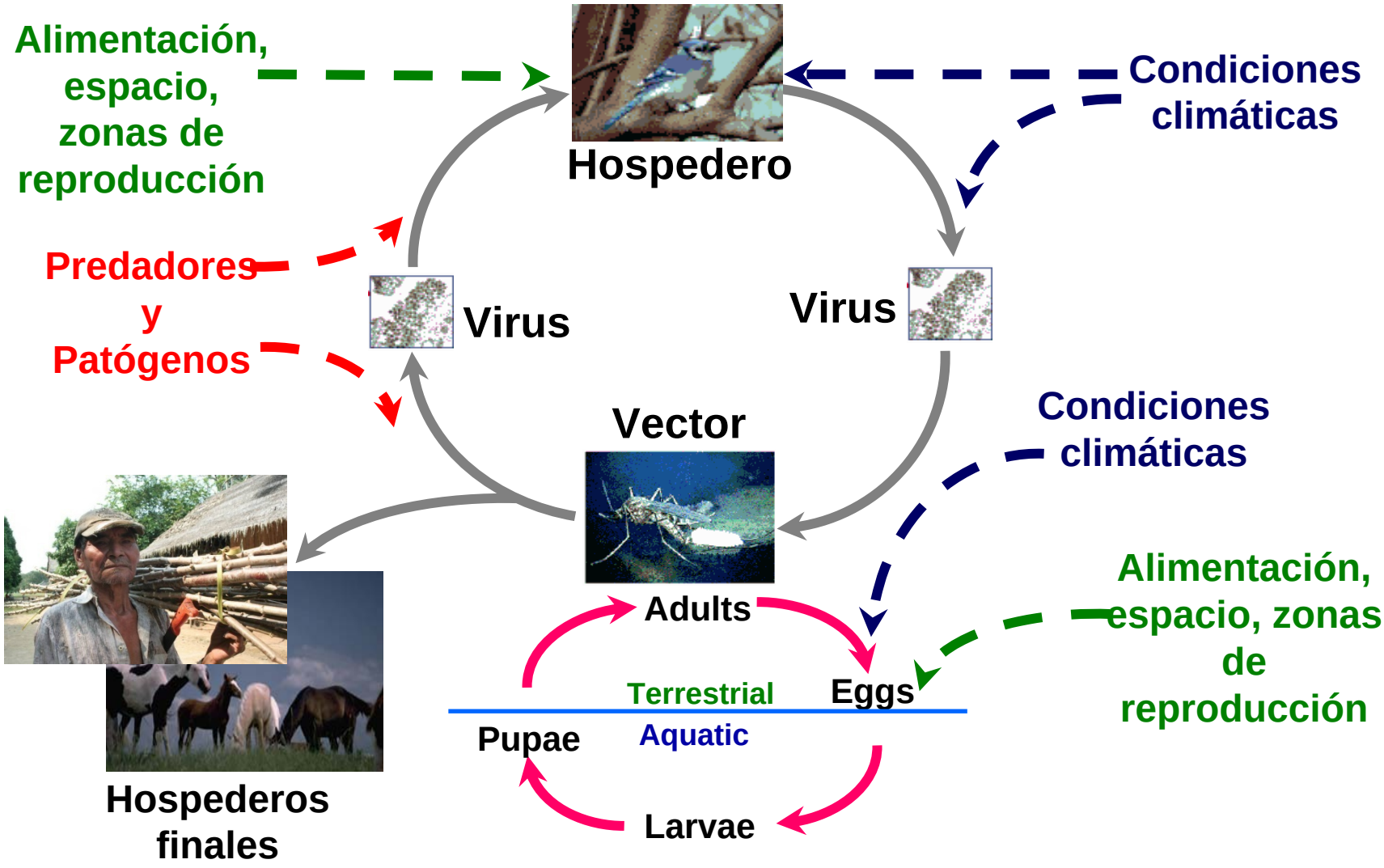
- Nuevo paradigma:
  - Mejor entendimiento de la dinámica de las enfermedades teniendo en cuenta el componente ambiental.
  - Multicausalidad en el origen de las enfermedades genera la necesidad de un enfoque transdisciplinario para enfrentarlas.

Arbovirus: Ciclo de Transmisión

(arthropod-borne viruses)



Arbovirus: Ciclo de Transmisión



nature Vol 451|21 February 2008|doi:10.1038/nature06536

LETTERS

Global trends in emerging infectious diseases

Kate E. Jones[1], Nikkita G. Patel[2], Marc A. Levy[3], Adam Storeygard[3]†, Deborah Balk[3]†, John L. Gittleman[4] & Peter Daszak[2]

- **Las enfermedades emergentes son en su mayoria causadas por zoonosis (60.3%)**
- **Un 70.3% de las enfermedades emergentes causadas por zoonosis tienen origen en la fauna silvestre y tienen un incremento significativo a través del tiempo.**

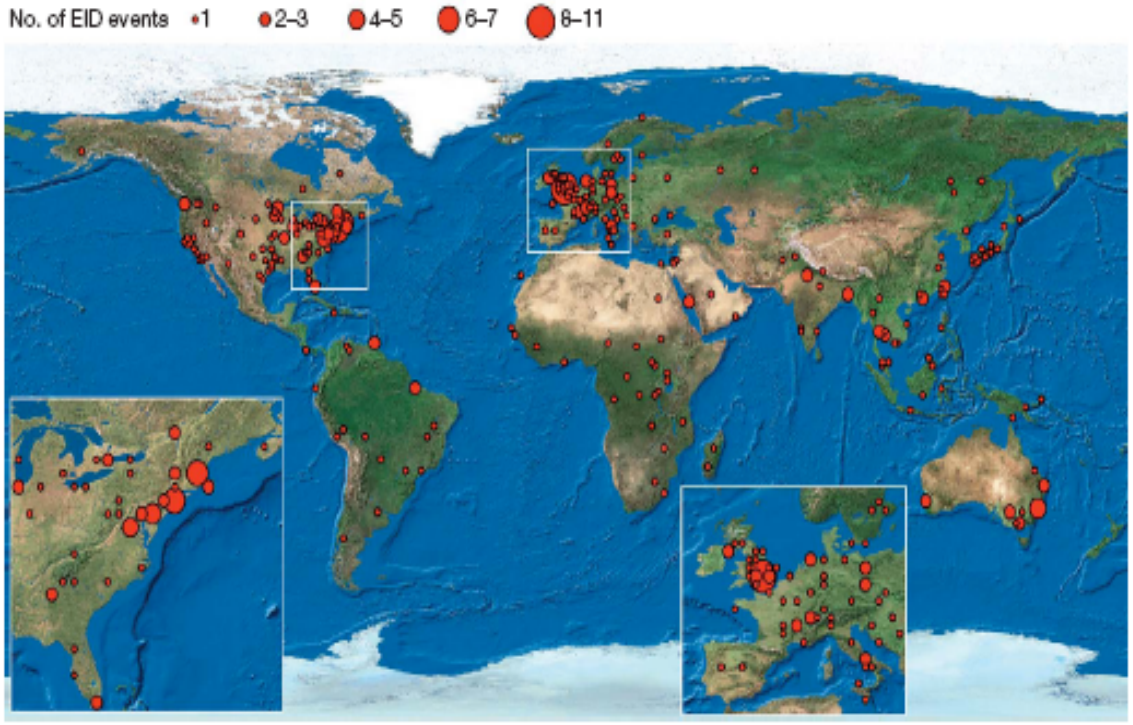
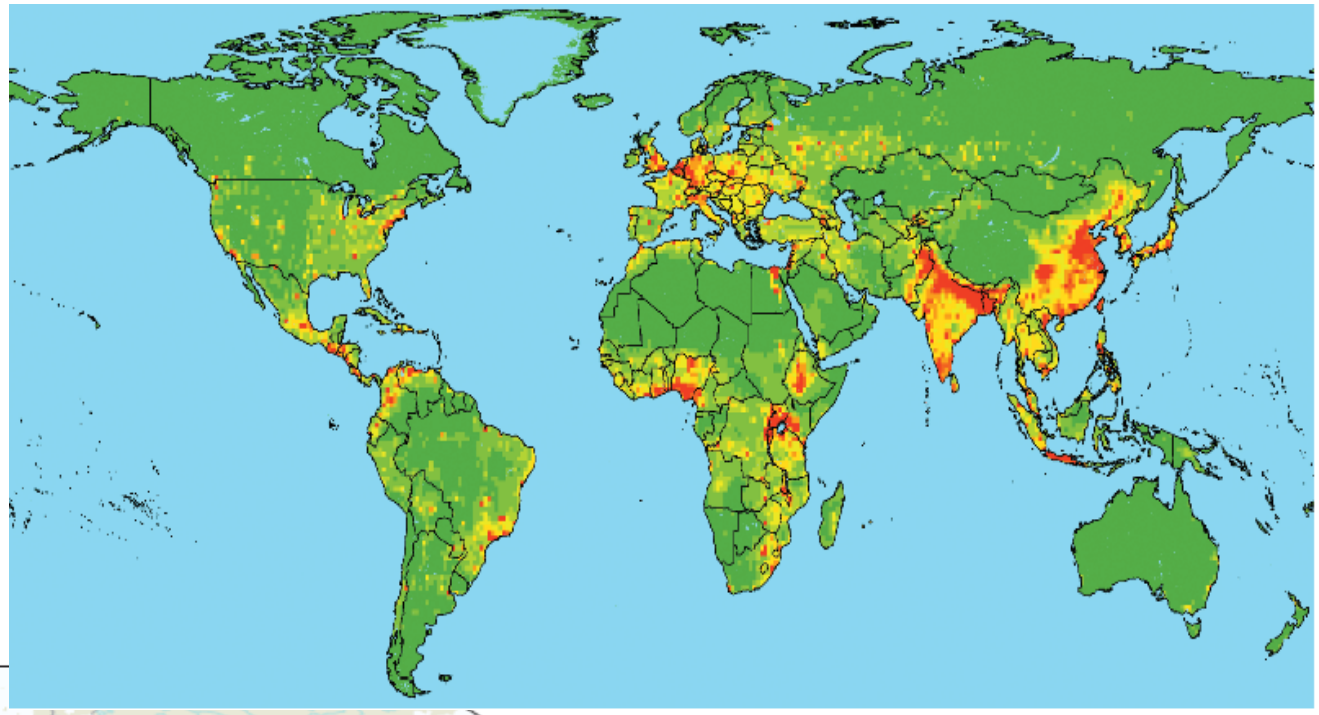
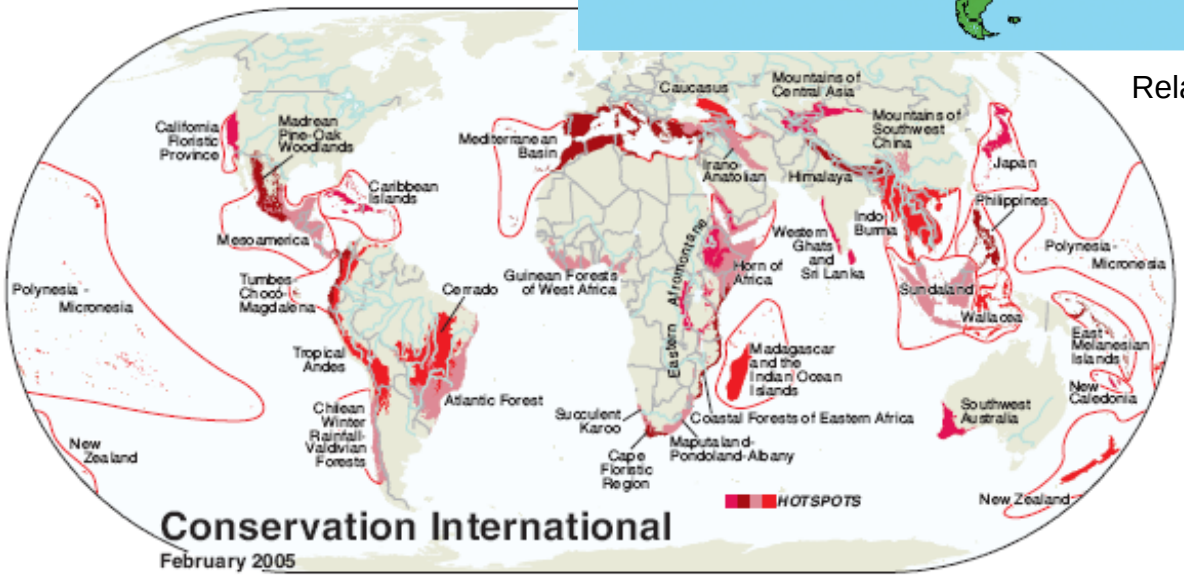


Figure 2 | Global richness map of the geographic origins of EID events from 1940 to 2004. The map is derived for EID events caused by all pathogen types. Circles represent one degree grid cells, and the area of the circle is proportional to the number of events in the cell.



BIODIVERSITY HOTSPOTS



Relative geographic risk of emerging or re-emerging infectious diseases that originate with zoonotic pathogens from wildlife

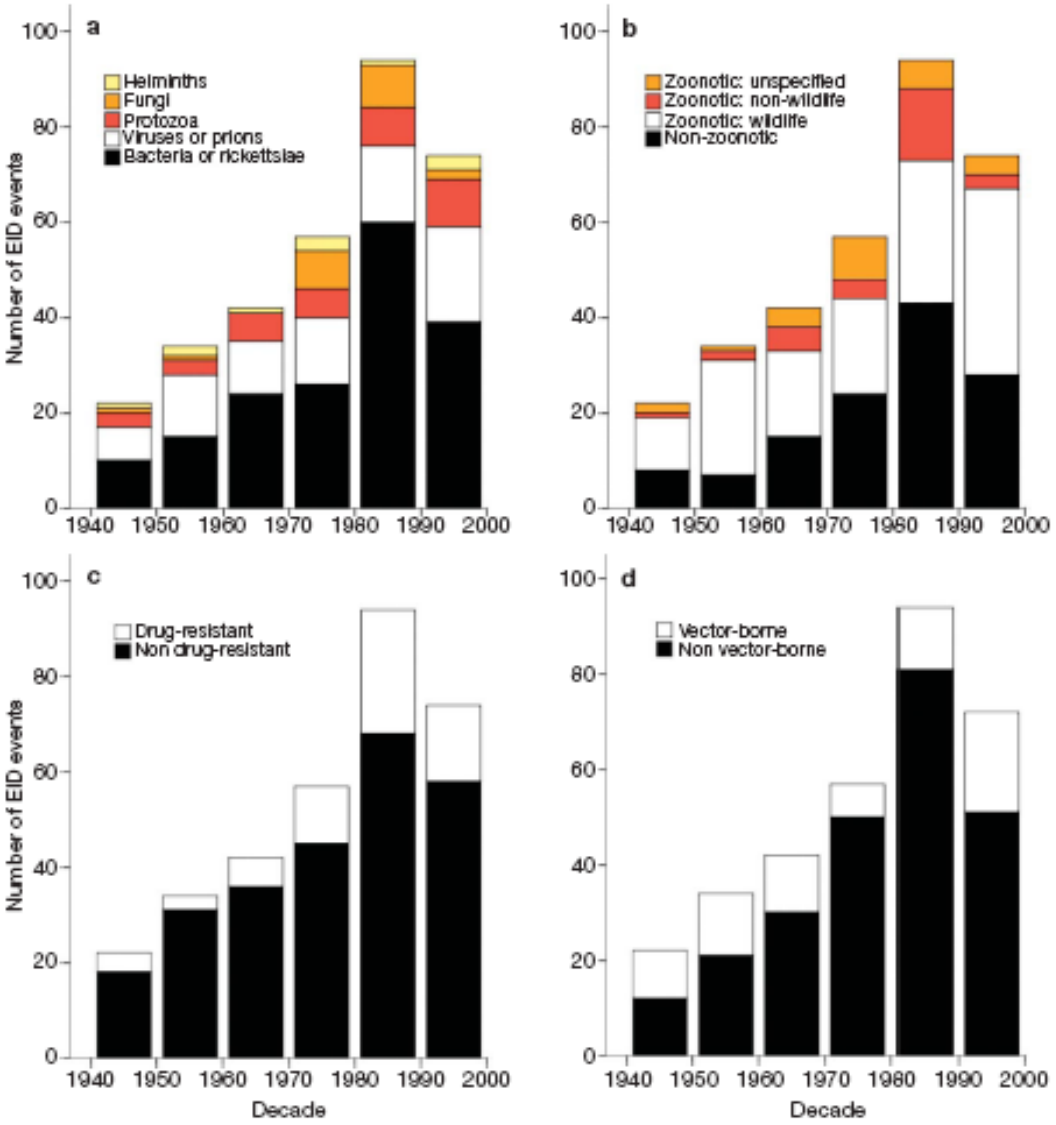
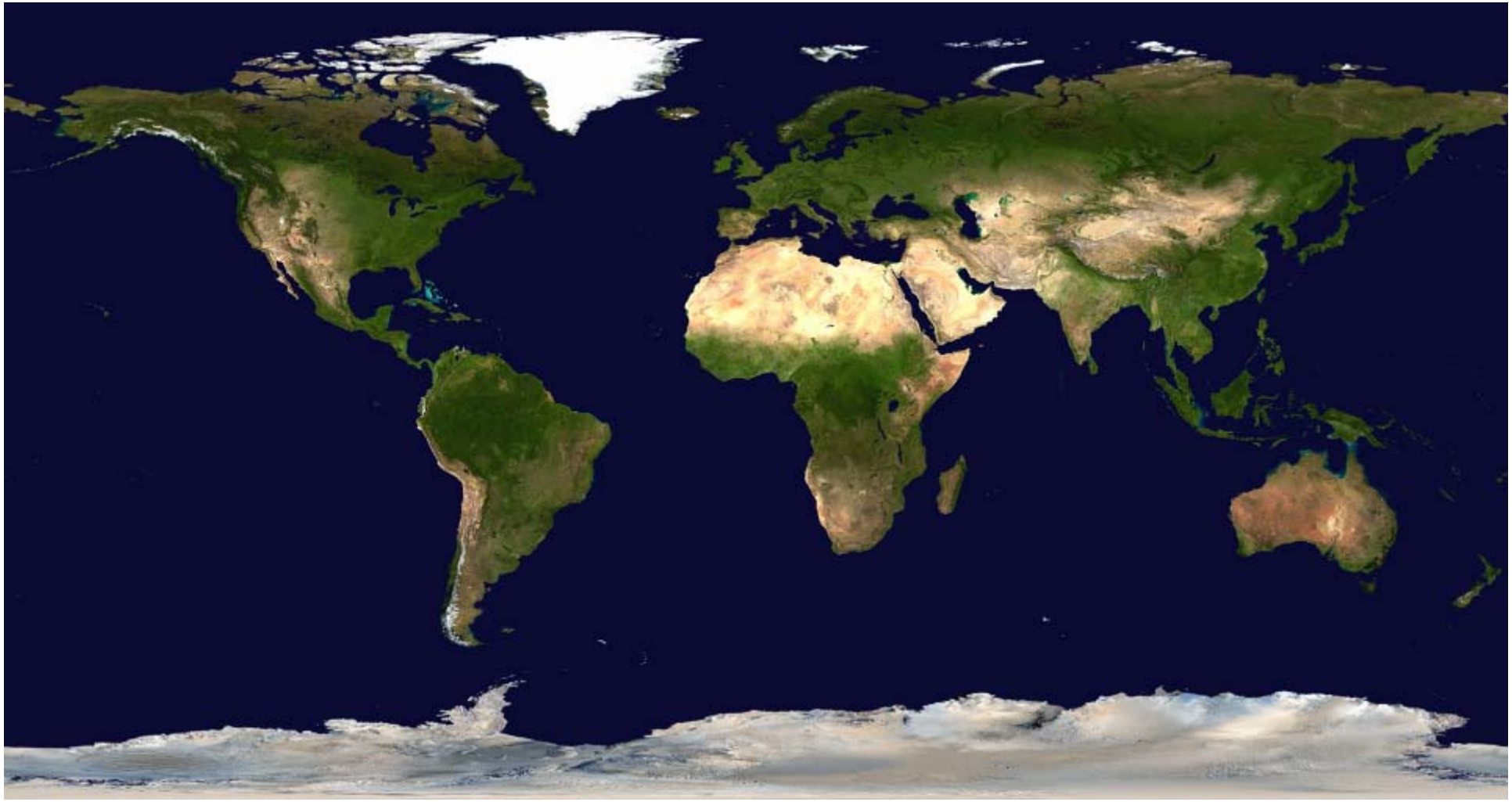
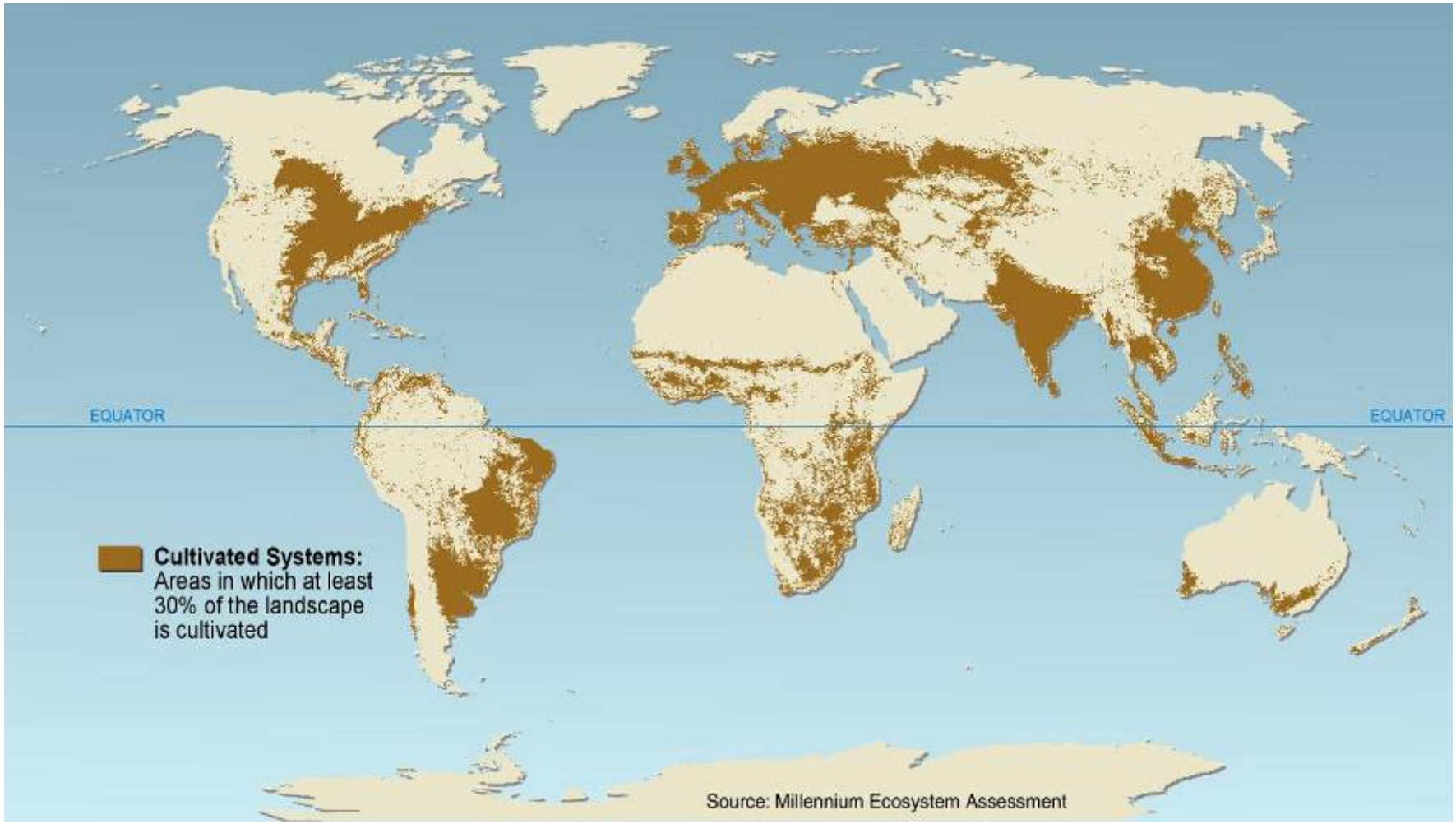


Figure 1 | Number of EID events per decade. EID events (defined as the temporal origin of an EID, represented by the original case or cluster of cases that represents a disease emerging in the human population—see Methods) are plotted with respect to **a**, pathogen type, **b**, transmission type, **c**, drug resistance and **d**, transmission mode (see keys for details).



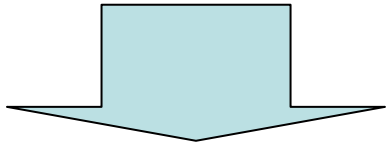
Source: NASA


EQUATOR
EQUATOR
Cultivated Systems:
Areas in which at least
30% of the landscape
is cultivated
Source: Millennium Ecosystem Assessment

Nuevas Enfermedades

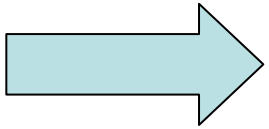
Factores que facilitan la dispersión de enfermedades emergentes

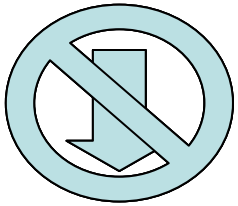
- Monoculturas y simplificación de habitat
- Destrucción de habitat
- Penetración humana en áreas “aisladas” (Invasión a nuevos nichos ecológicos)
- Decline de predadores
- Dominancia de generalistas sobre especialistas

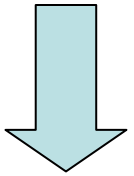


PÉRDIDA DE SERVICIOS ECOSISTÉMICOS

Hendra virus



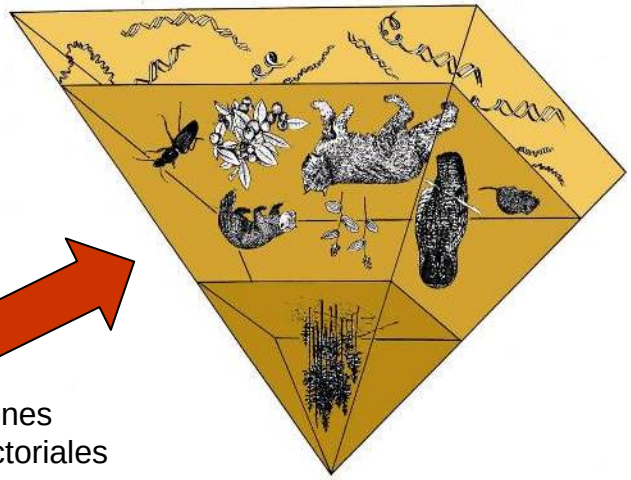




Relaciones multifactoriales

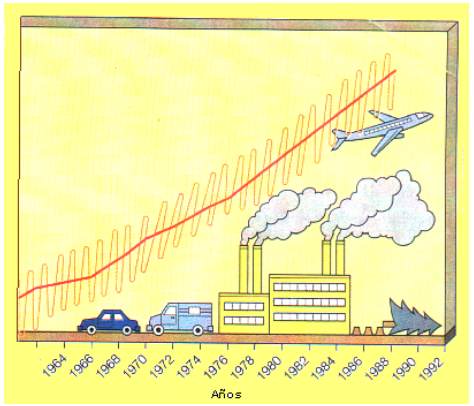
Enfermedades emergentes

Relaciones multifactoriales

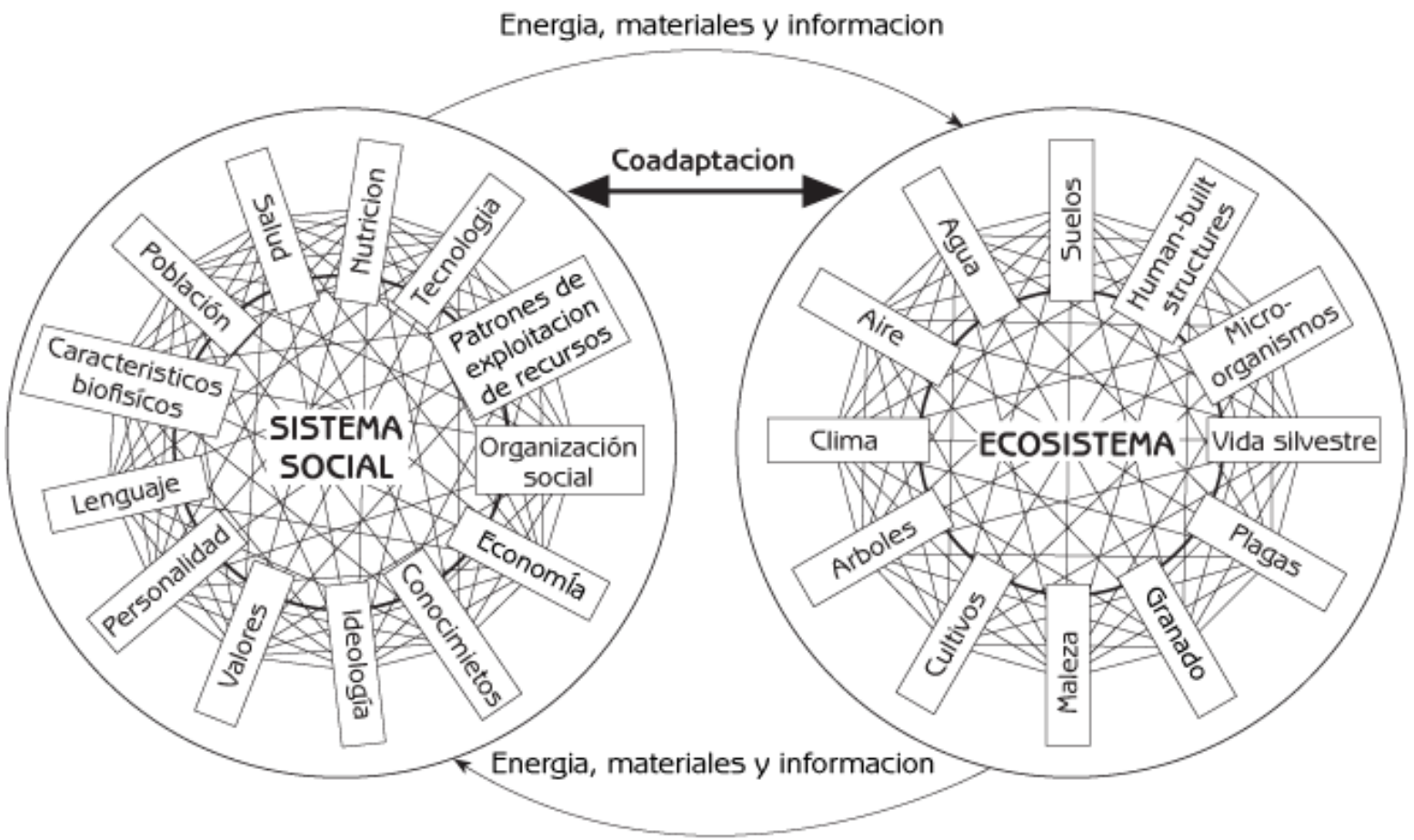


Relaciones multifactoriales

Pérdida de biodiversidad

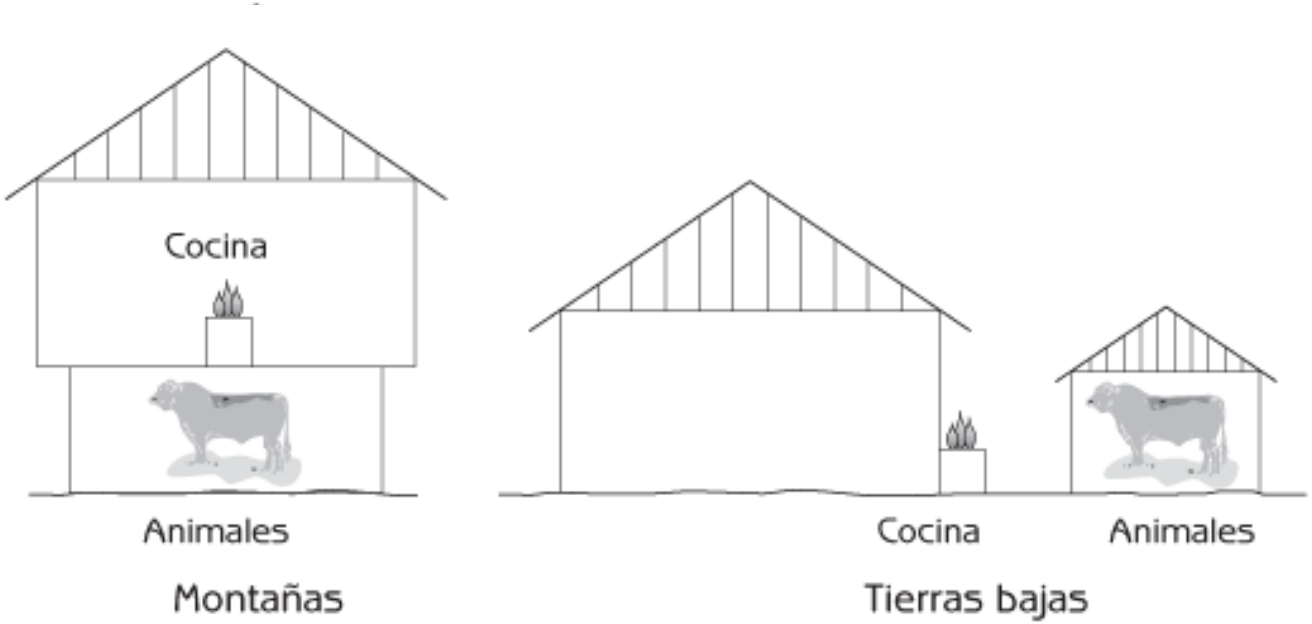


Cambio global



Interacción, coevolución y coadaptación del sistema social humano con el ecosistema. Fuente: Adaptado de *Rambo, A. & Sjise, T. (1985) An Introduction to Human Ecology Research on Agricultural Systems in Southeast Asia, University of the Philippines, Los Banos, Philippines*

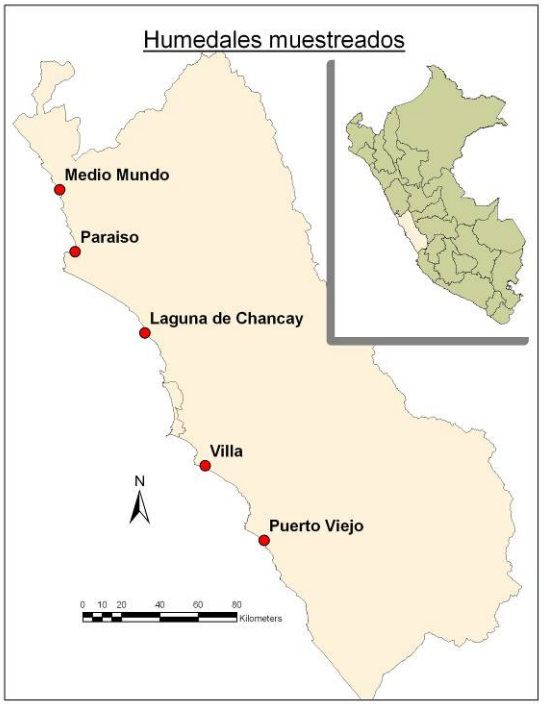
Vivienda tradicional de las montañas y tierras bajas en Vietnam.

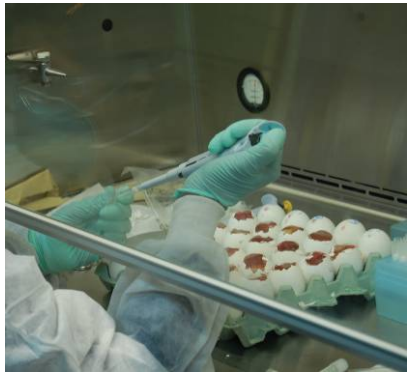


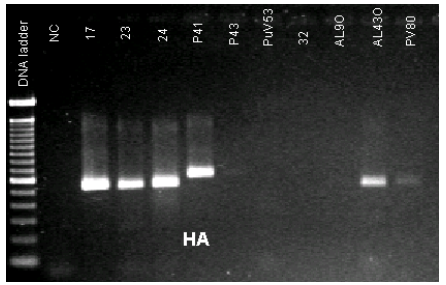
Las sociedades tradicionales típicamente están bien coadaptadas por tener lazos fuertes a su sistema de apoyo ambiental que les permiten conocer a fondo al mismo.

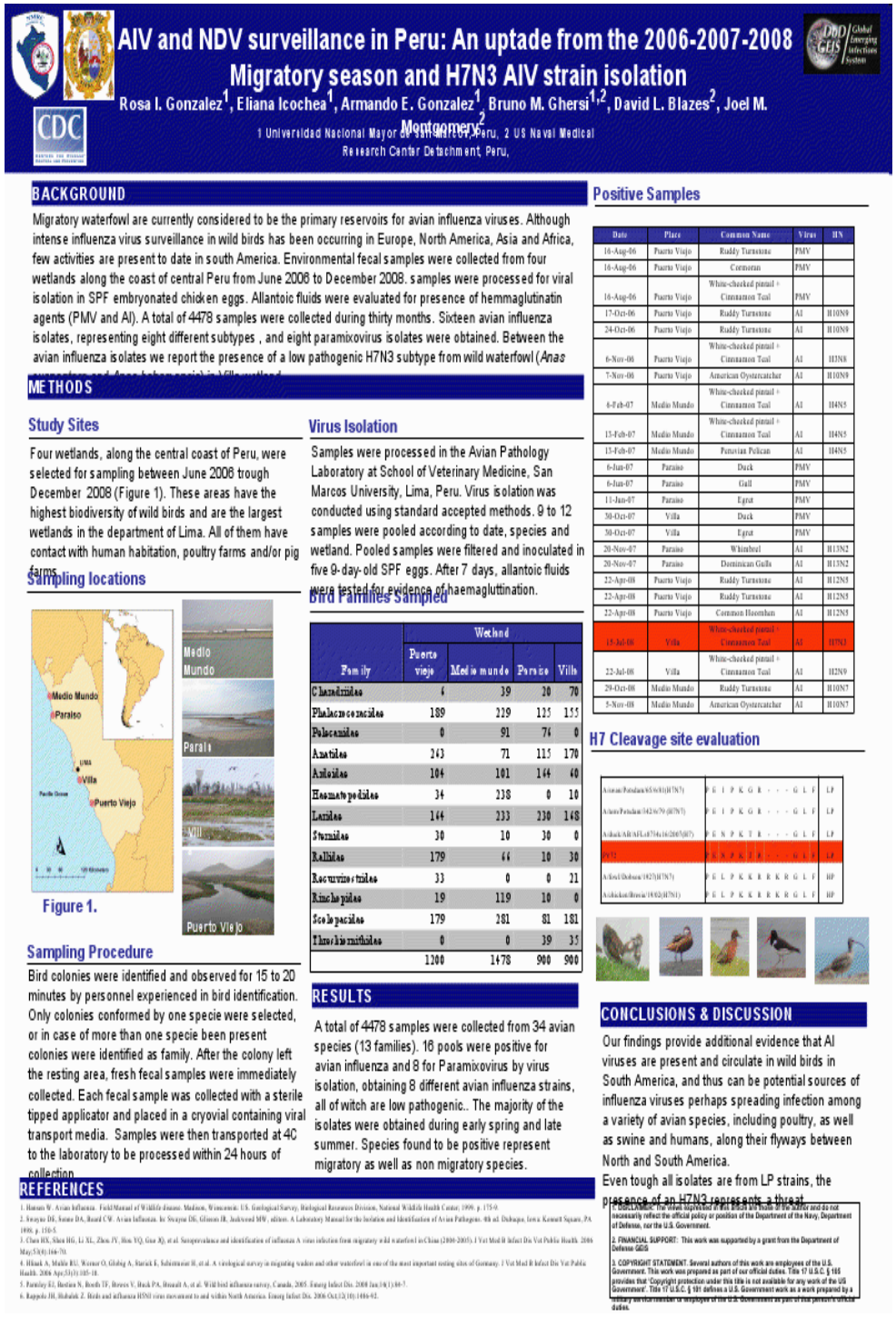
Avian influenza wild birds surveillance

- Determine the subtypes of AI circulating in wild birds in Peru
- Determine the bird species that act as carriers
- Five different wetlands in central Peru during 3 ½ years (2006-2009)
- 6887 environmental fecal samples collected from 34 avian species (13 families)
- 30 Avian Influenza isolates, 12 different subtypes.









AIV and NDV surveillance in Peru: An uptade from the 2006-2007-2008 Migratory season and H7N3 AIV strain isolation

Rosa I. Gonzalez[1], Eliana Icochea[1], Armando E. Gonzalez[1], Bruno M. Ghersi[1,2], David L. Blazes[2], Joel M. Montgomery[2]

1 Universidad Nacional Mayor de San Marcos, Peru, 2 US Naval Medical Research Center Detachment, Peru,

BACKGROUND

Migratory waterfowl are currently considered to be the primary reservoirs for avian influenza viruses. Although intense influenza virus surveillance in wild birds has been occurring in Europe, North America, Asia and Africa, few activities are present to date in south America. Environmental fecal samples were collected from four wetlands along the coast of central Peru from June 2006 to December 2008. samples were processed for viral isolation in SPF embryonated chicken eggs. Allantoic fluids were evaluated for presence of hemmaglutinatin agents (PMV and AI). A total of 4478 samples were collected during thirty months. Sixteen avian influenza isolates, representing eight different subtypes , and eight paramixovirus isolates were obtained. Between the avian influenza isolates we report the presence of a low pathogenic H7N3 subtype from wild waterfowl (*Anas*

METHODS

Study Sites

Four wetlands, along the central coast of Peru, were selected for sampling between June 2006 trough December 2008 (Figure 1). These areas have the highest biodiversity of wild birds and are the largest wetlands in the department of Lima. All of them have contact with human habitation, poultry farms and/or pig farms.

Sampling locations

Figure 1.

Sampling Procedure

Bird colonies were identified and observed for 15 to 20 minutes by personnel experienced in bird identification. Only colonies conformed by one specie were selected, or in case of more than one specie been present colonies were identified as family. After the colony left the resting area, fresh fecal samples were immediately collected. Each fecal sample was collected with a sterile tipped applicator and placed in a cryovial containing viral transport media. Samples were then transported at 4C to the laboratory to be processed within 24 hours of collection.

Virus Isolation

Samples were processed in the Avian Pathology Laboratory at School of Veterinary Medicine, San Marcos University, Lima, Peru. Virus isolation was conducted using standard accepted methods. 9 to 12 samples were pooled according to date, species and wetland. Pooled samples were filtered and inoculated in five 9-day-old SPF eggs. After 7 days, allantoic fluids were tested for evidence of haemagluttination.

Bird Families Sampled

Family	Wetland			
	Puerto viejo	Medio mundo	Paraiso	Villa
Charadriidae	4	39	20	70
Phalacrocoracidae	189	229	125	155
Pelecanidae	0	91	74	0
Anatidae	243	71	115	170
Ardeidae	104	101	144	40
Haematopodidae	34	238	0	10
Laridae	144	233	230	148
Sternidae	30	10	30	0
Rallidae	179	44	10	30
Recurvirostridae	33	0	0	21
Rinchopidae	19	119	10	0
Scolopacidae	179	281	81	181
Threskiornithidae	0	0	39	35
	1200	1478	900	900

RESULTS

A total of 4478 samples were collected from 34 avian species (13 families). 16 pools were positive for avian influenza and 8 for Paramixovirus by virus isolation, obtaining 8 different avian influenza strains, all of witch are low pathogenic.. The majority of the isolates were obtained during early spring and late summer. Species found to be positive represent migratory as well as non migratory species.

Positive Samples

Date	Place	Common Name	Virus	HN
16-Aug-06	Puerto Viejo	Ruddy Turnstone	PMV	
16-Aug-06	Puerto Viejo	Cormoran	PMV	
16-Aug-06	Puerto Viejo	White-cheeked pintail + Cinnamon Teal	PMV	
17-Oct-06	Puerto Viejo	Ruddy Turnstone	AI	H10N9
24-Oct-06	Puerto Viejo	Ruddy Turnstone	AI	H10N9
6-Nov-06	Puerto Viejo	White-cheeked pintail + Cinnamon Teal	AI	H3N8
7-Nov-06	Puerto Viejo	American Oystercatcher	AI	H10N9
6-Feb-07	Medio Mundo	White-cheeked pintail + Cinnamon Teal	AI	H4N5
13-Feb-07	Medio Mundo	White-cheeked pintail + Cinnamon Teal	AI	H4N5
13-Feb-07	Medio Mundo	Peruvian Pelican	AI	H4N5
6-Jun-07	Paraiso	Duck	PMV	
6-Jun-07	Paraiso	Gull	PMV	
11-Jun-07	Paraiso	Egret	PMV	
30-Oct-07	Villa	Duck	PMV	
30-Oct-07	Villa	Egret	PMV	
20-Nov-07	Paraiso	Whimbrel	AI	H13N2
20-Nov-07	Paraiso	Dominican Gulls	AI	H13N2
22-Apr-08	Puerto Viejo	Ruddy Turnstone	AI	H12N5
22-Apr-08	Puerto Viejo	Ruddy Turnstone	AI	H12N5
22-Apr-08	Puerto Viejo	Common Moorhen	AI	H12N5
15-Jul-08	Villa	White-cheeked pintail + Cinnamon Teal	AI	H7N3
22-Jul-08	Villa	White-cheeked pintail + Cinnamon Teal	AI	H2N9
29-Oct-08	Medio Mundo	Ruddy Turnstone	AI	H10N7
5-Nov-08	Medio Mundo	American Oystercatcher	AI	H10N7

H7 Cleavage site evaluation

CONCLUSIONS & DISCUSSION

Our findings provide additional evidence that AI viruses are present and circulate in wild birds in South America, and thus can be potential sources of influenza viruses perhaps spreading infection among a variety of avian species, including poultry, as well as swine and humans, along their flyways between North and South America.
Even tough all isolates are from LP strains, the presence of an H7N3 represents a threat.

REFERENCES

1. Hanson W. Avian Influenza. Field Manual of Wildlife Disease. Madison, Wisconsin: U.S. Geological Survey, Biological Resources Division, National Wildlife Health Center; 1999. p. 175-9.
2. Swayne DE, Senne DA, Beard CW. Avian Influenza. In: Swayne DE, Glisson JR, Jackwood MW, editors. A Laboratory Manual for the Isolation and Identification of Avian Pathogens. 4th ed. Dubuque, Iowa: Kennett Square, PA; 1998. p. 150-5.
3. Chen HX, Shao HG, Li XL, Zhou JY, Hou YQ, Guo XJ, et al. Seroprevalence and identification of influenza A virus infection from migratory wild waterfowl in China (2006-2007). J Vet Med B Infect Dis Vet Public Health. 2006 May;53(4):166-70.
4. Hilsuk A, Mielke HU, Werner O, Globig A, Harrick E, Suhrmann H, et al. A virological survey in migrating waders and other waterfowl in one of the most important resting sites of Germany. J Vet Med B Infect Dis Vet Public Health. 2006 Apr;53(3):105-18.
5. Pasvolsky EZ, Bastien N, Booth TF, Brown V, Buck PA, Brunelle A, et al. Wild bird influenza survey, Canada, 2005. Emerg Infect Dis. 2008 Jan;14(1):66-7.
6. Rappole JH, Hubalek Z. Birds and influenza H5N1 virus movement to and within North America. Emerg Infect Dis. 2006 Oct;12(10):1476-82.

DISCLAIMER: The views expressed in this article are those of the author and do not necessarily reflect the official policy or position of the Department of the Navy, Department of Defense, nor the U.S. Government.

2. FINANCIAL SUPPORT: This work was supported by a grant from the Department of Defense GEIS

CONCLUSIONS & DISCUSSION

Our findings provide additional evidence that AI viruses are present and circulate in wild birds in South America, and thus can be potential sources of influenza viruses perhaps spreading infection among a variety of avian species, including poultry, as well as swine and humans, along their flyways between North and South America. Even tough all isolates are from LP strains, the presence of an H7N3 represents a threat.

EVALUACIÓN SANITARIA DE ANIMALES DOMÉSTICOS, SILVESTRES Y HUMANOS EN LAS COMUNIDADES DE NUEVA ESPERANZA (RÍO YAVARÍ-MIRIM) Y SOL NACIENTE (RIO AMAZONAS)

OBJETIVOS

- Estudio de la prevalencia de enfermedades de mamíferos domésticos y mamíferos silvestres cazados.
- Evaluación sanitaria de los animales domésticos de abasto en las comunidades.
- Evaluación de la prevalencia de la malaria en las poblaciones humanas.
- Desarrollo de un programa de educación para las comunidades locales enfocado en la conservación, cría de animales domésticos y aspectos ecológicos sanitarios de los animales y de las poblaciones humanas.

INSTITUCIONES

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EVALUACIÓN SANITARIA DE ANIMALES DOMÉSTICOS, SILVESTRES Y HUMANOS EN LAS COMUNIDADES DE NUEVA ESPERANZA (RÍO YAVARÍ-MIRIM) Y SOL NACIENTE (RIO AMAZONAS)

Análisis de Malaria

Nueva Esperanza

Plasmodium Falciparum	6
Plasmodium Vivax	15
TOTAL INFECTADOS	21
TOTAL PERSONAS	78
PREVALENCIA	26,9

Prevalencia de Malaria en función de la presencia de sintomatología clínica (n=78)

SX	TOTAL	NEGATIVOS	POSITIVOS	FALCIPARUM	VIVAX	% POSITIVOS	% FALCIPARUM	% VIVAX
CON SX	12	8	4	1	3	33,3	8,3	25,0
SIN SX	65	48	17	5	12	26,2	7,7	18,5

Prevalencia de Malaria en función del trabajo de madera (n=78)

MADERA	TOTAL	NEGATIVOS	POSITIVOS	FALCIPARUM	VIVAX	% POSITIVOS	% FALCIPARUM	% VIVAX
SI MADERA	32	22	10	3	7	31,3	9,4	21,9
NO MADERA	45	34	11	3	8	24,4	6,7	17,8
TOTAL	77	56	21	6	15	27,3	7,8	19,5

Necesidades de investigación

- Integración entre la salud humana, animal y ecosistémica.
- Interacción entre los procesos ecológicos y evolutivos para determinar las dinámicas de las enfermedades.
- Rol de la ecología entre hospederos, patógenos y las interacciones entre múltiples patógenos.

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- Medición del riesgo y vigilancia de la emergencia de enfermedades a través de modelos predictivos teniendo en cuenta factores medioambientales.
- Monitorear la salud de los animales domésticos y silvestres

Acciones necesarias

- Identificación de ‘hotspots’ de potenciales enfermedades emergentes.
- Vigilancia de la vida silvestre.
- Desarrollo de estrategias de mitigación de enfermedades emergentes.
- Mantener la biodiversidad y los servicios que nos ofrece.

Acciones necesarias

- Creación de redes de trabajo interdisciplinarias e interinstitucionales.
- Mayor intercambio de información.
- Utilización de los principios de la ecología para el control de las enfermedades de hospederos múltiples, focalizándose en el descubrimiento y caracterización de patógenos.
- Desarrollo de vacunas.

La salud de todas las especies está conectada a través de las realidades ecológicas que gobiernan la vida en el planeta.

MEDICINA DE LA CONSERVACIÓN

Aproximación transversal al término de SALUD

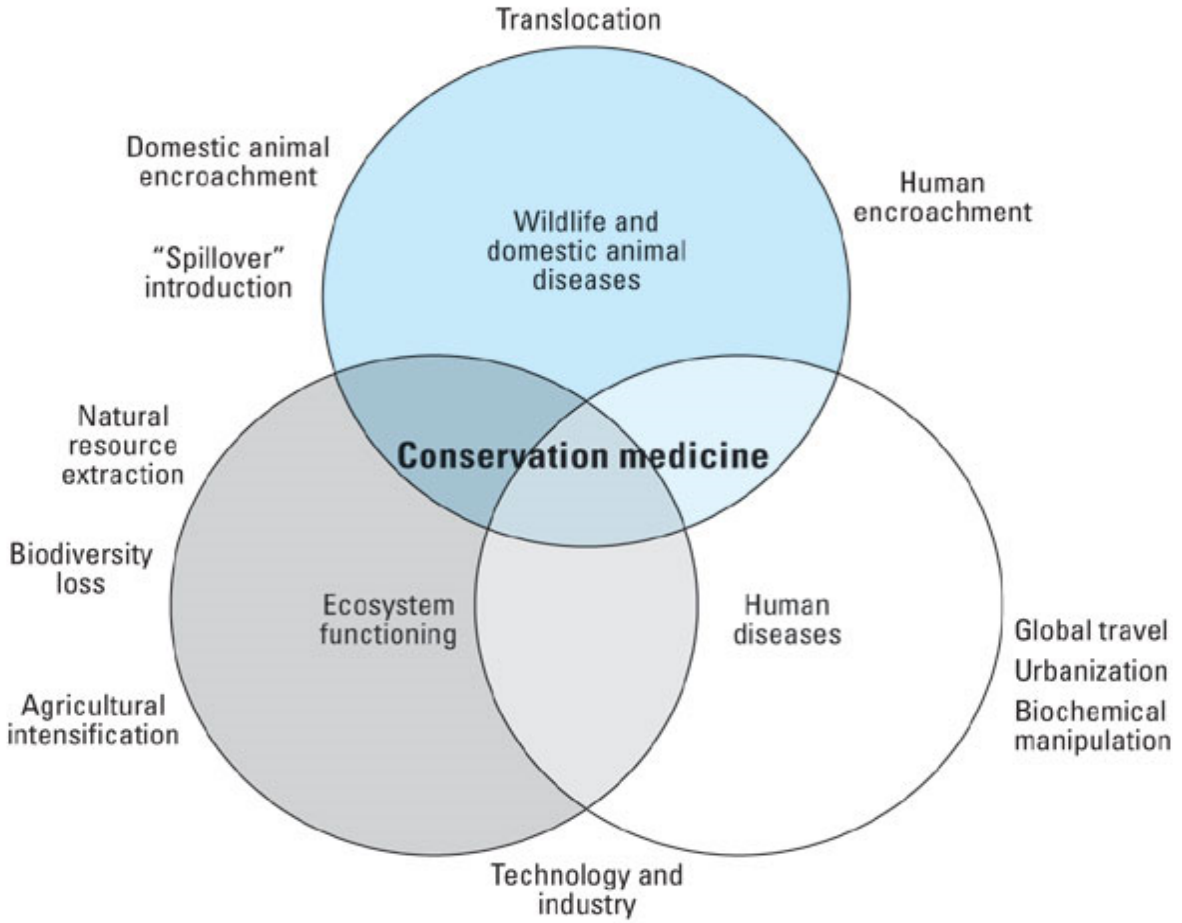

Figure 2. The main elements converging under the Consortium for Conservation Medicine. Conservation medicine combines conservation biology, wildlife veterinary medicine, and public health. Adapted from Tabor (2002).

MUCHAS GRACIAS POR SU ATENCIÓN

“Servicios ecosistémicos, ecología de las enfermedades y bienestar humano”

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Lanzamiento del Fondo Internacional para Proyectos de Investigación en Ecosistemas (ESPA)

Miraflores, 26 de Enero del 2010